

Impact of AI-based learning technology and teacher communication on student learning outcomes

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh teknologi pembelajaran berbasis AI dan komunikasi interpersonal guru terhadap hasil belajar siswa pada mata pelajaran dasar – dasar kejuruan kelas X MPLB di SMK Negeri 1 Surakarta baik secara parsial maupun simultan. Populasi penelitian adalah siswa kelas X MPLB dengan sampel sebanyak 82 siswa yang dipilih melalui teknik proporsional random sampling. Data dikumpulkan melalui kuesioner dan dokumentasi, lalu dianalisis menggunakan regresi linear berganda dengan bantuan SPSS versi 26. Hasil analisis menunjukkan: (1) terdapat pengaruh positif dan signifikan teknologi pembelajaran berbasis AI terhadap hasil belajar siswa ($t_{hitung} 2,262 > t_{tabel} 1,990$; signifikansi $0,026 < 0,05$), (2) tidak terdapat pengaruh signifikan komunikasi interpersonal guru terhadap hasil belajar siswa ($t_{hitung} -1,291 < t_{tabel} 1,990$; signifikansi $0,201 > 0,05$), dan (3) secara simultan, kedua variabel berpengaruh positif dan signifikan terhadap hasil belajar ($F_{hitung} 2,589 > F_{tabel} 2,370$; signifikansi $0,081 < 0,10$). Kontribusi efektif kedua variabel sebesar 6,2% sedangkan 93,8% dipengaruhi faktor lain di luar penelitian ini.

Keywords: inovasi pembelajaran digital; interaksi guru – siswa; pencapaian akademik

Abstract

This study aims to determine the impact of AI-based learning technology and teacher interpersonal communication on student learning outcomes in basic vocational subjects among Grade X Office Management and Business Services (MPLB) students at SMK Negeri 1 Surakarta, both partially and simultaneously. The research population consisted of Grade X MPLB students, with a sample of 82 students selected through proportional random sampling technique. Data were collected through questionnaires and documentation, then analyzed using multiple linear regression with SPSS version 26. Results demonstrate: (1) a significant positive impact of AI-based learning technology on student learning outcomes (t-calculated $2.262 > t\text{-table } 1.990$; significance $0.026 < 0.05$); (2) no significant impact of teacher interpersonal communication on student learning outcomes (t-calculated $-1.291 < t\text{-table } 1.990$; significance $0.201 > 0.05$); and (3) simultaneously, both variables have a positive and significant impact on student learning outcomes ($F_{hitung} 2.589 > F_{tabel} 2.370$; significance $0.081 < 0.10$). The effective contribution of both variables is 6.2%, while 93.8% is influenced by other factors outside the scope of this study.

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table 1.990; significance $0.201 > 0.05$); and (3) simultaneously, both variables have a significant positive impact on learning outcomes ($F\text{-calculated } 2.589 > F\text{-table } 2.370$; significance $0.081 < 0.10$). The effective contribution of both variables is 6.2%, while 93.8% is influenced by other factors outside this study.

Keywords: academic achievement; digital learning innovation; teacher - student interaction

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Introduction

The fourth industrial revolution has brought significant changes to the working world and influenced various aspects of life, including education. Education plays a crucial role in human development. Through education, individuals can understand their environment, recognize their roles in society, and prepare themselves to face future challenges (Dermawan et al., 2023). Education can occur in three forms: formal, non-formal, and informal. Formal education includes schools, colleges, or universities. Non-formal education encompasses courses or training programs. Meanwhile, informal education is acquired through daily experiences or activities. All forms of education must include cognitive, affective, and psychomotor aspects to provide comprehensive and profound learning experiences.

Education and learning outcomes have a very close relationship. Education aims to improve student learning outcomes in terms of knowledge, skills, and attitudes. Learning outcomes represent the achievement manifestation from processes undergone during learning. According to Prastiyo (as cited in Damayanti, 2022), learning outcomes constitute an accumulation of processes undertaken in learning. According to Suyuti et al. (2023), learning outcomes reflect students' understanding of subject matter, their ability to apply concepts in daily life, and their skills in problem-solving. Yuniwati and Masruri (2016) state that good learning outcomes can reflect strong learning processes and understanding of subject matter. This encompasses not only academic grade improvements but also critical thinking development and problem-solving skills. Learning outcome achievement is not limited to academic grades alone but also includes students' abilities in independent thinking, collaboration, and adaptation to real-world challenges.

However, various problems related to learning outcomes still exist in practice. Many students experience difficulties in achieving established learning standards. Problems related to low student learning outcomes also occur at SMK Negeri 1 Surakarta in the Office Management and Business Services (MPLB) program for Grade X students in Basic Vocational Subjects. Based on preliminary research data, some students still receive grades below minimum standards, reflecting problems in understanding and skills being taught. Based on evaluation results of Grade X MPLB 3 students at SMK Negeri 1 Surakarta in Basic Vocational Subjects, student learning outcomes remain below the Minimum Completeness Criteria (KKM) of 80. In skills aspects, 88% of students obtained grades below KKM, with 35% not proficient, 24% less proficient, and 29% sufficiently proficient. In text formatting skills, 94% of students had not achieved KKM, consisting of 44% not proficient and 50% sufficiently proficient. In image or table insertion aspects, 53% of students received grades below KKM, with 38% not proficient and 15% sufficiently proficient. Meanwhile, in collaboration skills aspects, 82% of students had not achieved KKM, consisting of 32% not proficient and 50% sufficiently proficient. These conditions indicate that student understanding and material mastery remain suboptimal, resulting in low learning outcomes.

Based on several studies, numerous factors influence learning outcomes: teaching methods, learning technology utilization, student guidance and support, teacher quality, and facilities and infrastructure (Setiawan, 2021). Other factors influencing learning outcomes can be internal and external factors (Damayanti, 2022). Internal factors are aspects originating from within individuals,

such as interest, motivation, attention, learning readiness, memory, concentration, and cognitive, affective, and psychomotor abilities. Meanwhile, external factors include family, learning methods, learning environment, teachers, and peers (Anggraini, 2019).

One factor potentially influencing student learning outcomes is the use of AI-based learning technology, where previous research shows that AI has significant potential in improving student learning outcomes by providing more effective, flexible, and engaging learning experiences (Shiva et al., 2024). Research by Tsai et al. (2021) and Agestiningrum and Siswanto (2024) supports these findings. Tsai et al.'s (2021) study shows that AI implementation improves students' concept understanding and problem-solving abilities. Meanwhile, research by Agestiningrum and Siswanto (2024) proves that AI-based learning systems can increase student access to learning materials and learning personalization.

Implementation of AI (Artificial Intelligence)-based learning technology utilization offers great potential for current learning process revolution (Rustan & Junaid, 2024). AI enables learning personalization, increases student engagement, and enriches learning experiences where each student can receive materials and teaching methods adapted to their needs, interests, and learning styles. AI can improve learning effectiveness by providing more accurate assessments and rapid feedback. Additionally, AI can quickly analyze individual student needs and provide more appropriate learning recommendations (Indarta et al., 2022).

Another factor that can influence student learning outcomes is teacher interpersonal communication, which is supported by previous research showing that teacher interpersonal communication has positive impacts on student learning outcomes (Buro, 2017). Similarly, research by Hidayati (2020) found similar results that effective teacher interpersonal communication has positive influence on student learning outcomes. In other words, the better the communication between teachers and students, the higher the likelihood for students to achieve satisfactory results.

Effective teacher interpersonal communication can create stronger bonds between teachers and students, making students feel more motivated and comfortable in the learning process (Yeni & Susanti, 2023). Communication itself is essentially a process of message delivery from communicators to communicants aimed at changing attitudes, opinions, and behaviors (Buro, 2017). Meanwhile, interpersonal communication is communication that is flexible in nature with mutual feedback between one another, where all parties mutually provide and receive input (Kurniawan, 2020).

Based on this background, this research aims to answer several main questions: (1) Does AI-based learning technology influence student learning outcomes in basic vocational subjects at SMK N 1 Surakarta? (2) Does teacher interpersonal communication influence student learning outcomes in basic vocational subjects at SMK N 1 Surakarta? and (3) Do AI-based learning technology and teacher interpersonal communication together influence student learning outcomes in basic vocational subjects at SMK N 1 Surakarta? By answering these questions, this research is expected to provide deeper insights for schools, teachers, students, and other researchers to improve learning quality for SMK students.

Research Methods

This research employed a quantitative approach with correlational quantitative methods to analyze the influence of AI-based learning technology and teacher interpersonal communication on learning outcomes in Basic Vocational Subjects focusing on Grade X MPLB students at SMK Negeri 1 Surakarta. This research was conducted in seven stages: research preparation, research proposal development, instrument determination and development, data collection, data processing and analysis, conclusion drawing, and research report preparation. The population in this research totaled 103 students, with a sample of 82 Grade X MPLB students at SMK N 1 Surakarta. The sampling technique used was proportional random sampling. This research was conducted offline or directly using Google Forms for questionnaire distribution and documentation related to student names and student learning outcome data.

Data collection techniques were conducted using closed questionnaires based on 5-point Likert scales, where respondents chose answers most appropriate to their conditions. Additionally, student learning outcome data were also collected through documentation. Data analysis techniques

included data tabulation preparation, classical assumption tests (normality, linearity, multicollinearity, and heteroscedasticity tests), and hypothesis testing including multiple linear regression analysis, t-tests, F-tests, and determination coefficients. Researchers also calculated effective and relative contributions to examine each variable's contribution to learning outcomes.

Results and Discussion

Research Results

This research used data collection methods through questionnaire distribution for independent variables (X) and grade data from summative assessments for dependent variables (Y). Before use, questionnaires were pilot tested to ensure validity and reliability. This pilot test was conducted by distributing questionnaires to 34 Grade XI Office Management students. Research questionnaires consisted of 20 statements for AI-based learning technology variables (X_1). Validity test results showed that 18 statements were declared valid, while 2 statements were invalid. For teacher interpersonal communication variables (X_2), questionnaires also consisted of 20 statements, with validity test results showing 19 valid statements and 1 invalid statement. Invalid statements were deleted because other valid statements were available that represented measured aspects. Therefore, only valid statements were used in this research.

Reliability test results showed that questionnaires for each variable had good reliability levels. AI-based learning technology variables (X_1) had reliability values of 0.826, while teacher interpersonal communication variables (X_2) had reliability values of 0.931. Because both values were greater than 0.60, all questionnaires in this research were declared reliable and usable. Descriptive statistics data from each variable in this research are presented as follows.

Based on data collection results through summative tests in Basic Vocational Subjects at SMK Negeri 1 Surakarta, mean values of 74 were obtained. This variable had maximum values of 90 and minimum values of 48, with value ranges of 42. The total overall scores obtained from student learning outcome totals were 6,104. AI-based learning technology variables consisted of 18 statements with Likert scales 1-5, completed by 82 respondents, obtaining mean values of 68. This variable had maximum values of 86 and minimum values of 52, with value ranges of 34. The total overall scores obtained from all respondents were 5,587. Teacher interpersonal communication variables consisted of 19 statements with Likert scales 1-5, completed by 82 respondents, obtaining mean values of 75. This variable had maximum values of 95 and minimum values of 54, with value ranges of 41. The total overall scores obtained from all respondents were 6,160.

Prerequisite tests used in this research were normality tests, linearity tests, multicollinearity tests, and heteroscedasticity tests. Normality test results showed Asymp. Sig. (2-tailed) values of 0.20, where these values were greater than 0.05. Therefore, obtained significance values > 0.05 indicate that data in this research are normally distributed. Linearity test results between AI-based learning technology (X_1) and student learning outcomes (Y) showed significance values in deviation from linearity rows of 0.292. These significance values were greater than 0.05. Therefore, it can be concluded that AI-based learning technology variables and student learning outcomes have linear relationships. Linearity test results between teacher interpersonal communication (X_2) and student learning outcomes (Y) showed significance values in deviation from linearity rows of 0.780. These significance values were greater than 0.05. Therefore, it can be concluded that teacher interpersonal communication variables and student learning outcomes have linear relationships. Based on multicollinearity test results, AI-based learning technology variables had tolerance values of 0.77 and VIF values of 1.28. Teacher interpersonal communication variables had tolerance values of 0.77 and VIF values of 1.28. These three variables had tolerance values > 0.10 and VIF values < 10 . Therefore, it can be concluded that these three variables do not have multicollinearity symptoms. Heteroscedasticity test calculation results using scatterplot tests in this research showed no specific patterns, and data points were unevenly scattered around zero lines on Y-axes. Table 1 presents the t-test results, which examine the individual or partial influence of independent variables on the dependent variable.

Table 1

T-Test Results

	T _{calculated}	Significance
(Constant)	6,999	,000
AI-Based Learning Technology	2,262	,026
Teacher Interpersonal Communication	-1,291	,201

(Source: Data processed by researchers, 2025)

Based on Table 1, t-tests were conducted to determine independent variable influences individually or partially on dependent variables. Based on t-test results, AI-Based Learning Technology variables had significance values of $0.026 < 0.05$, besides t-calculated values for this variable being $2.262 > t\text{-table } 1.990$. This indicates that H_0 is rejected and H_1 is accepted, so it can be concluded that AI-based learning technology has positive and significant influence on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Subsequently, teacher interpersonal communication variables had significance values of $0.201 > 0.05$, with t-calculated values of $-1.291 < t\text{-table } 1.990$. Based on these results, H_0 is accepted and H_2 is rejected, meaning that teacher interpersonal communication does not have positive and significant influence on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Table 2 presents the F-test results, which examine the simultaneous influence of independent variables on the dependent variable.

Table 2*F-Test Results*

Sum of Squares	df	Mean Square	F	Signifikansi
Regresion	386,833	2	193,417	2,589
Residual	5901,362	79	74,701	
Total	6288,195	81		0,081b

(Source: Data processed by researchers, 2025)

Based on Table 2, significance values for AI-based learning technology (X_1) and teacher interpersonal communication (X_2) variables toward student learning outcomes (Y) were 0.081. Because this significance value is smaller than the 0.10 significance level ($0.081 < 0.10$) and F-calculated values are greater than F-table values of 2.589 ($2.589 > 2.370$), H_0 is rejected and H_a is accepted. Therefore, it can be concluded that AI-based learning technology (X_1) and teacher interpersonal communication (X_2) together have significant positive influence on student learning outcomes (Y) at 10% significance level. Table 3 presents the multiple linear regression analysis results, providing the regression equation for this study.

Table 3*Multiple Linear Regression Analysis Results*

	B	Std. Error	Beta
(Constant)	63,106	9,016	
AI-Based Learning Technology	,314	,139	,280
Teacher Interpersonal Communication	-,134	,104	-,160

(Source: Data processed by researchers, 2025)

Based on Table 3, the regression equation obtained in this research is:

$$\hat{Y} = 63,106 + 0,314.X_1 - 0,134.X_2 + e$$

Based on the regression equation above, interpretations can be made as follows: (1) The positive constant of 63.106 indicates that if AI-based learning technology (X_1) and teacher

interpersonal communication (X_2) equal zero (0), then student learning outcome values (Y) are predicted to be 63.106; (2) The regression coefficient for AI-based learning technology variables (X_1) of 0.314 indicates that every increase in AI-based learning technology variables by one unit will result in student learning outcome increases of 0.314, assuming teacher interpersonal communication variables (X_2) equal zero (0); (3) The regression coefficient for teacher interpersonal communication variables (X_2) of -0.134 can be interpreted that every increase in teacher interpersonal communication by one unit will result in student learning outcome decreases of 0.134, assuming AI-based learning technology variables (X_1) equal zero (0). Table 4 presents the coefficient of determination analysis results, showing the proportion of variance explained by the independent variables.

Table 4*Coefficient of Determination Analysis Results*

R	R Square	Adjusted R Square	Std. Error of the Estimate
.248 ^a	.062	.038	8,64296

(Source: Data processed by researchers, 2025)

Based on Table 4, coefficient of determination (R Square) values are 0.062 or 6.2%, meaning the influence of AI-based learning technology and teacher interpersonal communication on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta is 6.2%, while the remainder ($100\% - 6.2\% = 93.8\%$) is influenced by other variables not explained in this research.

Discussion

The Impact of AI-Based Learning Technology on Student Learning Outcomes in Basic Vocational Subjects for Grade X MPLB Students at SMK Negeri 1 Surakarta

AI-based learning technology has an impact on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Based on testing results, findings show H_0 rejected and H_1 accepted. This is supported by t-test results showing $t_{\text{calculated}} > t_{\text{table}}$ ($2.262 > 1.990$) with significance values of $0.026 < 0.05$. Therefore, it can be concluded that AI-based learning technology has positive and significant influence on student learning outcome variables in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

This hypothesis aligns with research conducted by Shiva et al. (2024), which explains that AI implementation enables higher completion rates in learning processes, improves learning outcomes, and strengthens information retention. This shows that AI can help students understand materials well through more interactive learning experiences adapted to individual needs. Similar results are found in research by Zawacki et al. (2019), which states that AI can improve student learning outcomes through several mechanisms, such as adaptive learning, automatic evaluation systems, and intelligent tutors. Additionally, AI also plays roles in facilitating more flexible learning, enabling students to learn anytime and anywhere.

AI-based learning technology in this research is based on adaptive learning concepts and intelligent evaluation systems aimed at improving student learning outcomes. AI is used as a learning aid in learning processes, enabling students to search for information, complete assignments, and develop new ideas supporting their understanding of subject materials. Therefore, based on conducted data processing, it can be determined that the higher the AI-based learning technology, the higher student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

The Impact of Teacher Interpersonal Communication on Student Learning Outcomes in Basic Vocational Subjects for Grade X MPLB Students at SMK Negeri 1 Surakarta

Teacher interpersonal communication has an impact on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Based on hypothesis testing results, findings show H_0 accepted and H_1 rejected. This is supported by t-test results showing

t -calculated < t -table ($-1.291 < 1.990$) with significance values of $0.201 > 0.05$. Therefore, it can be concluded that teacher interpersonal communication does not have positive and significant influence on student learning outcome variables in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

Research findings contradict research conducted by Putra et al. (2022), which shows that effective interpersonal communication between teachers and students has positive and significant impacts on student understanding and academic achievement. Additionally, other research by Syahrudin (2022) also reveals that interpersonal communication, both individually and together with other factors like learning motivation, has significant impacts on learning outcomes. However, these research results align with findings by Artaverlina and Wulandari (2021), which state that educator interpersonal communication does not significantly influence student learning outcome variables. These result differences indicate that teacher interpersonal communication is not the main factor determining student learning outcomes in this research.

Research results show that teacher interpersonal communication does not provide significant impacts on student learning outcomes. AI-based learning dominance, high student learning independence, and learning methods more oriented toward technology become other factors that very possibly cause teacher interpersonal communication to not have significant relationships with student learning outcomes in this research.

The Impact of AI-Based Learning Technology and Teacher Interpersonal Communication on Student Learning Outcomes in Basic Vocational Subjects for Grade X MPLB Students at SMK Negeri 1 Surakarta

AI-based learning technology and teacher interpersonal communication variables simultaneously have positive and significant influences on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. These findings are supported by F-test results, where F-calculated values are greater than F-table ($2.589 > 2.370$) with significance values of 0.081 below the 0.10 threshold. Therefore, H_0 is rejected and H_a is accepted, indicating that simultaneously AI-based learning technology and teacher interpersonal communication contribute to student learning outcome improvements in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

Coefficient of determination analysis results show R square values of 0.062, indicating that AI-based learning technology and teacher interpersonal communication variables contribute 6.2% to student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Meanwhile, 93.8% of variations in student learning outcomes are influenced by other factors not included in this research. Additionally, based on effective contribution analysis results, AI-based learning technology contributions to student learning outcomes are 5.8%, while teacher interpersonal communication has contributions of 0.4%. These findings show positive relationships between AI-based learning technology implementation and teacher interpersonal communication with student learning outcome improvements in Basic Vocational Subjects.

Based on these findings, conclusions are strengthened that AI-based learning technology implementation and teacher interpersonal communication simultaneously play roles in improving student learning outcomes. Testing data results show that if students receive optimal AI-based learning technology, students will more easily understand subject materials, increase learning independence, and obtain better learning outcomes. Additionally, if teacher interpersonal communication is optimal, students will feel more supported in learning processes, more motivated, and have deeper understanding of taught materials. Good interactions between teachers and students can create more comfortable learning atmospheres, increase student involvement in discussions, and help them overcome learning difficulties. Therefore, the more optimal AI-based learning technology implementation and teacher interpersonal communication in learning processes, the higher the potential for student learning outcome improvements in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

Conclusion

Based on successfully collected data and conducted analyses, conclusions that can be stated are: (1) There is positive and significant influence of AI-based learning technology on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Conducted data analysis results obtained significance values of 0.026, meaning not more than 0.05, indicating influence. Therefore, the better AI-based learning technology used by students, the higher student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta; (2) There is no positive and significant influence of teacher interpersonal communication on student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. Conducted data analysis results obtained significance values of 0.201, meaning more than 0.05, indicating no influence. These findings show that every increase in teacher interpersonal communication will result in decreases in student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta; and (3) There is positive significant simultaneous influence between AI-based learning technology and teacher interpersonal communication with student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. This is proven by significance values of $0.081 < 0.10$. Additionally, R square results are 0.062. Other factors not studied in this research amount to 93.8%. Furthermore, effective contribution calculation results for AI-based learning technology variables (X_1) to student learning outcomes (Y) are 5.8%, while teacher interpersonal communication (X_2) contributes 0.4%. For relative contribution calculation results, AI-based learning technology variables (X_1) to student learning outcomes (Y) are 93%, and relative contributions of teacher interpersonal communication variables (X_2) to student learning outcomes (Y) are 7%. Therefore, the more optimal AI-based learning technology implementation and teacher interpersonal communication in learning processes, the higher the potential for student learning outcome improvements in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta. AI-based learning technology is more dominant compared to teacher interpersonal communication in influencing student learning outcomes in Basic Vocational Subjects for Grade X MPLB students at SMK Negeri 1 Surakarta.

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